SCIENCE AND TECHNOLOGY BENEFIT ANALYSIS

Idaho Operations Office – Idaho National Engineering and Environmental Laboratory
Bechtel BWXT Idaho LLC

Enhanced SWEPP RTR System

The Real-Time Radioscopy (RTR) System upgrade was deployed July 2001 for the Transuranic Waste Program (ID-WM-103) at the Radioactive Waste Management Complex (RWMC) Stored Waste Examination Pilot Plant (SWEPP) facility. The RTR system upgrade was primarily implemented to improve reliability of the system, minimize the maintenance down time experienced with the old RTR system/cart , and mitigate the attendant production schedule programmatic risks. The enhanced RTR system also provides for increased performance capabilities and operating efficiency for the RTR production operation. The 3100 m3 project is a critical project with a completion milestone of end December 2002 as per the Idaho Settlement Agreement. The potential consequences of missing the milestone are difficult to quantify, however a missed milestone could result both in fines and halting of future DOE spent nuclear fuel shipments into the state of Idaho.

The RTR system/technology is a key part of the non-destructive assay and examination systems which provide for the required characterization of TRU wastes to meet certification requirements for transport to and disposal at the WIPP. The RTR provides an accepted method to non-intrusively examine the waste drum interiors via X-rays to determine in part the physical types of waste materials present, their spatial distribution, and the amounts of free liquids present. The original SWEPP RTR system was first brought into service in 1988. The drum examination process involved moving the cart into the shielded enclosure, closing the door, rotating the drums, and scanning the drums using the vertical drive equipment. The X-ray image was collected and sent to a closed circuit television monitor. Determination of liquids within the drums was difficult with this process. Therefore, a sequence to jog the cart by repetitive back and forth motion of the cart forward/reverse switch was adopted in order to identify liquids by producing visible wave motion. Jogging of the cart was not a part of the original design basis for the system and consistently caused mechanical failure of the cart drive gearbox. The original system also utilized a number of older parts unique to that early system, which is no longer produced, making the parts difficult to obtain and in some cases no longer available.

Ultimately due to system wear, the lack of available spare parts, changes in process requirements, and observed general increases in operations downtime, an upgrade to the system was undertaken to enable its continued and required availability for production operations. The upgrade included modifications to the RTR shielded enclosure, a new cart, three new drum rotator/joggers, new vertical drives, a new and more powerful X-ray system, a new control and electronics system, a control room ergonomic upgrade, and associated documentation. The system provides improved performance capabilities due to these additional/upgraded features. The system will provide for increased throughput, less downtime due to fewer and shorter maintenance periods, improved reliability, improved safety features, and increased ergonomics. The deployment of the RTR system helps satisfy the INEEL S&T need ID-3.1.06 "Advanced Nuclear Assay for CH-TRU Waste Drums".

Enhanced RTR System

Qualitative Benefit Analysis		
Programmatic Risk	●	The primary reason for the RTR system upgrade was to minimize the maintenance down time experienced with the old system/cart and to mitigate the attendant production schedule risks. The new cart also provides for increased performance capabilities and operating efficiency of the RTR production operation. The 3100 m3 project is a critical project with a completion milestone of end December 2002 as per the Idaho Settlement Agreement. The potential consequences of missing the milestone are difficult to quantify, however a missed milestone could result both in fines and halting of future DOE spent nuclear fuel shipments into the state of Idaho.
Technical Adequacy	●	The system meets all requirements for required RTR performance and provides improved performance due to additional process features. With an availability[1] of at least 80% the system will provide for increased throughput (4 drums per hour). The upgraded RTR system includes a state-of-the-art electronic control system, a new, more powerful X-ray system for more exact imaging through the drums, commercial vertical drive mechanisms, a modified shielded cave structure, and upgraded ergonomic operator control features and control room. Operators may now control the majority of equipment functions, at the operator control station, by either of two methods, a console switch box and a joystick that should assist to prevent operator fatigue. The system is now more effective, powerful, and easy to use.
Safety	◒	The system upgrade provided additional safety features including emergency stop buttons, an upgrade to the X-ray safety interlock system, an electric switch for opening the shielded enclosure door from inside, and an ergonomic upgrade to the operator control room.
Schedule Impact	●	The upgraded system will provide assurance of the necessary drum throughput necessary to meet milestones established in the settlement agreement. Without the upgrade, the former system would not have been capable of completing the RTR operations tasks/throughput required, due to recurring failures of the cart drive system and the X-ray system. At the time the former system was removed from service for the upgrade, both subsystems were undergoing significant maintenance on a weekly basis.

●	◒	○	◓	◉
Major improvement	Some improvement	No change	Somewhat worse	Major Decline

Quantitative Benefit Analysis	
Cost Impact Analysis	The upgrade to the RTR system yields cost benefits both through directly reduced operations and maintenance costs and the avoidance/reduction of potential programmatic risks/costs that would result from failure to meet commitments established under the Idaho Settlement agreement. Net cost savings estimated from improvement in direct operations and maintenance costs are $929/drum for an approximate total of $5.5 million projected future direct annual savings. Programmatic risks/costs avoidance impact of the upgrade providing assurance of meeting the Idaho Settlement Agreement is difficult to quantify (avoidance of the DOE costs resulting from Idaho fines and halting of DOE/Navy shipments of spent nuclear fuel to the INEEL, etc), but could easily be very much greater.

[1] Based upon 24 hours per day and 7 days per week.

Estimate Basis for Enhanced RTR System

Worksheet 1: Operating & Maintenance Annual Recurring Costs

Expense Cost Items *	Before (B) Annual Costs	After (A) Annual Costs
1. Equipment	$ -	$ -
2. Purchased Raw Materials and Supplies	$ -	$ -
3. Process Operation Costs:	$ -	$ -
Utility Costs	$ -	$ -
Labor Costs	$ -	$ -
Routine Maintenance Costs for Processes	$8,693,652	$3,214,410
Other	$ -	$ -
Subtotal	$8,693,652	$3,214,410
4. PPE and Related Health/Safety/Supply Costs	$ -	$ -
5. Waste Management Costs:		
Waste Container Costs	$ -	$ -
Treatment/Storage/Disposal Costs	$ -	$ -
Inspection/Compliance Costs		$ -
Subtotal	$ -	$ -
6. Recycling Costs		
Material Collection/Separation/Preparation Costs:		
a) Material and Supply Costs	$ -	$ -
b) Operations and Maintenance Labor Costs	$ -	$ -
Vendor Costs for Recycling	$ -	$ -
Subtotal	$ -	$ -
7. Administrative/other Costs	$ -	$ -
Total Annual Cost:	$8,693,652	$3,214,410

Estimate Basis for Enhanced RTR System

Worksheet 2: Itemized Project Funding Requirements*
(i.e., One Time Implementation Costs)

Category	Cost $
INITIAL CAPITAL INVESTMENT	
1 Design/Development	$ 300,000
2 Purchase	$ 300,000
3 Installation	$ 200,000
4 Other Capital Investment (explain)	
Subtotal: Capital Investment= (C)	$ 800,000
INSTALLATION CAPITAL EXPENSES	
1 Planning/Procedure Development	$ -
2 Training	$ -
3 Miscellaneous Supplies	$ -
4 Startup/testing (certification testing and Apps Mods)	$ -
5 Readiness Reviews/Management Assessment/Administrative Costs	$ -
6 Other Installation Operating Expenses (explain)	$ -
Subtotal: Installation Operating Expense = (E)	$1,100,000
7 All company adders (G & A/PHMC Fee, MPR, GFS, Overhead, taxes, etc.)(if not contained in above items)	$ -
Total Project Funding Requirements=(C + E)	$1,900,000
Useful Project Life = (L) 1.25 Years Time to Implem 6 Months	
Estimated Project Termination/Disassembly Cost (if applicable) = (D) (Only for Projects where L<5 years; D=0 if L>5 years)	$ -
TOTAL LIFE-CYCLE COST SAVINGS CALCULATION FOR IPABS-IS	
(Before - After) x (Useful Life) - (Total Project Funding Requirements + Termination)	
Total Life Cycle Cost Savings Estimate = (B - A) x L - (C+E+D)	
RETURN ON INVESTMENT CALCULATION	
Return on Investment (ROI) % = *(Before - After) - [(Total Project Funding Requirements + Termination)/Useful Life]* / *[Total Project Funding Requirements + Project Termination]* *x 100*	
ROI = (B-A)-[(C+E+D)/L / (C+E+D) x 100 = 208%	

O&M Annual Recurring Costs:			Project Funding Requirements:			
Annual Costs, Before=	$8,693,652	(B)	Capital Investment=	$ 800,000	(C)	
Annual Costs, After=	$3,214,410	(A)	Installation Op. Exp=	$ 1,100,000	(E)	
Net Annual Savings=	$5,479,242	(B-A)	Total Project Funds=	$ 1,900,000	(C+E)	

Note: Before (B) and After (A) are Operating & Maintenance Annual Recurring Costs from Worksheet 1.

Enhanced RTR System

GENERAL

The original INEEL 3100 m^3 Stored Waste Examination Pilot Plant (SWEPP) Real-Time Radioscopy (RTR) System provided many years of valuable service for radioscopic examination of waste containing 55-gallon drums. However, after much use (including use of processes beyond its design basis) and the passage of time, the system essentially wore out. This was demonstrated by marked increases in system failures and corrective maintenance. System availability declined rapidly and parts became very difficult to find and expensive to obtain (some critical unique X-ray system parts were no longer being produced). Therefore, in order to enable the RTR performance needed to assure meeting the 3100 m^3 end year 2002 milestone, an RTR system upgrade was undertaken. The upgrade resulted in the redesign and replacement of all of the moving equipment (cart, vertical drives, electronics and controls, and X-ray system). Additionally, the RTR shielded enclosure was upgraded (due to higher performance category constraints) and the RTR operator control system and control room was upgraded to provide an improved ergonomic environment for operations personnel.

INITIAL CAPITAL INVESTMENT

Initial capital investment for design/development, purchase/fabrication, and technical support for the RTR system upgrades installation at SWEPP was approximately $800k of the total $1.9 M upgrade project cost.

INSTALLATION AND START-UP

Production operations system installation/implementation capital costs were approximately $1.1 M of the total $1.9M upgrade project cost. These installation and startup costs included setup and testing of the equipment/system, removal of the old system, reinforcement of the RTR shielded enclosure, transfer of equipment from the mockup to SWEPP, installation of new electronic control cabinets, making necessary conduit and wire runs, installation of new X-ray system vertical drives, X-ray system, drum transfer cart cable routing and cabling, new drum transfer cart, additions to the existing emergency stop system, operator control room modifications, final setup and testing of the system , operations reviews and training, and all required operations supporting documentation.

TRADITIONAL (BASELINE) TECHNOLOGY/METHOD

The baseline RTR process included a system for RTR characterization of materials contained within 55-gallon drums. The system consisted of a 3-drum transport cart (with simultaneous rotation), electrical circuits to control and operate the cart, an X-ray system for imaging through the drums, an image collection/intensification system for collecting the image and converting it into information that could be viewed on a closed circuit television (CCTV) monitor and recorded for later viewing and validation, custom vertical drive mechanisms for raising and lowering the X-ray head and image intensifier, the shielded cave structure, and an operators control room. The baseline process included characterization of three drums on the cart. Each drum was placed in front of the X-ray head/image intensifier. The operations person moved the X-ray head and image intensifier up and down relative to the drum and recorded audio and video information throughout the characterization process. In addition, the operator would jog the cart to generate wave motion of any liquids that may be inside the drum. This process of jogging provided valuable information relative to liquid content and volume but resulted in consistent and frequent mechanical failure of the cart drive system.

NEW TECHNOLOGY/METHOD

The upgraded RTR system includes a new 3-drum transport cart (including individual drum rotation/jogging stations for each drum), state-of-the-art electronic control system, a new and more powerful X-ray system for more exact imaging through the drums, commercial vertical drive mechanisms for raising and lowering the X-ray head and image intensifier, the modified shielded cave structure, and an upgraded ergonomic operator control room. Operators may now control the majority of equipment functions, at the operator control station, by either of two methods. These are the console switch box and the joystick and should assist to prevent operator fatigue, by addition of operational diversity.

Enhanced RTR System

COST SAVINGS/COST AVOIDANCE/RISK REDUCTION

Direct cost savings have been estimated considering the expected reduction in future operations and maintenance activities/costs required to perform RTR examinations for the remaining TRU waste drums inventory needed to meet the 3100 m3 project commitment. The cost savings were estimated from comparison of RTR operations and maintenance annual costs in the year before upgrade implementation with the projected RTR operations and maintenance annual costs (as per detailed work plans) for FY02, the year after deployment. Prior year maintenance and operations costs were approximately $1474/drum, while projected future operations and maintenance costs are $545/drum. Net annual direct cost savings resulting is estimated at $5.5M (FY02). It should be noted that most (84%) of this total forecast cost savings results from the expected reduced maintenance costs. The attendant annual ROI is 208% based on the formula in Worksheet 2. Although it has not been quantified, the cost/risk avoidance associated with avoiding the programmatic cost consequences of the potential complete breakdown of the old RTR system and potential attendant failure to achieve the 3100 m^3 milestone could easily be much larger (DOE will avoid the potential negative impact costs of penalty fines and delays (halting) of spent nuclear fuel shipments).

SCIENCE AND TECHNOLOGY BENEFIT ANALYSIS DEPLOYMENT APPROVALS

Technology Deployed: **Enhanced SWEPP RTR System**

Date Deployed: **July 11, 2001**

EM Program(s) Impacted: **Transuranic Waste Program**

Approval Signatures

[signature] 9-11-01
Contractor Program Manager Date

N/A
Contractor Program Manager Date

[signature] 9-12-01
DOE-ID Program Manager Date

N/A
DOE-ID Program Manager Date